Proposed Plan for DNAPL Cleanup
NSG Former South Plant MGP Superfund Site
Waukegan, Illinois

Community Participation

EPA and Illinois EPA provide information regarding the North Shore Gas Former South Plant MGP Superfund site to the community by holding public meetings, maintaining an Administrative Record for the site, and publishing announcements in the *Lake County News Sun*. Through these means, EPA and Illinois EPA encourage the public to gain a more comprehensive understanding of the Superfund activities that have been conducted at the site. Site information can also be found at www.epa.gov/region5 /cleanup/northshoregassouth.

EPA maintains the site Administrative Record, which contains the information EPA used to develop the proposed site remedy, at the following locations:

Waukegan Public Library 128 N. County Street Waukegan, Illinois Hours: 10AM – 6PM (847) 623-2041	EPA Region 5 77 W. Jackson St. 7th Floor Records Center Chicago, Illinois M-F 8AM to 4PM

EPA will be accepting written comments on the South Plant MGP site Proposed Plan at www.epa.gov/region5/cleanup/northshoregassouth during the public comment period, which **will run for a total of thirty (30) days from May 6, 2015 to June 5, 2015.** Written comments may also be sent to the following address:

Heriberto Leon
Community Involvement Coordinator
United States Environmental Protection Agency
Mail Code SI-7J
77 W. Jackson Blvd. Chicago, IL 60604

EPA will host an open house at 3:00 pm and hold a **public meeting** at 6:00 pm on May 20, 2015 to discuss all the alternatives and the preferred remedy. Written and oral comments will be accepted at the meeting. The meeting will be at:

Bowen Park – Lilac Cottage
1911 North Sheridan
Waukegan, IL 60079

I. INTRODUCTION

The U.S. Environmental Protection Agency (EPA), in consultation with the Illinois Environmental Protection Agency (Illinois EPA), is issuing this Proposed Plan to present its preferred cleanup alternative for addressing the pool of undissolved tar-like material, called “dense, nonaqueous phase liquid (DNAPL),” that is found beneath the North Shore Gas (NSG) Company Former South Plant Manufactured Gas Plant (MGP) Superfund site in Waukegan, Illinois. EPA recommends that **Alternative D5**, Physically Enhanced DNAPL Recovery, be installed to address the DNAPL, which is the primary source of groundwater contamination at the site.

EPA will explain the rationale for proposing the preferred alternative in this document, as well as describing all the alternatives that were evaluated for DNAPL cleanup. This document also describes site history, including previous investigations and response actions performed.

EPA is issuing this Proposed Plan as the lead oversight agency for the site. Illinois EPA is providing support. EPA, in consultation with Illinois EPA, will select a remedy for DNAPL cleanup after reviewing and considering all information submitted during a 30-day public comment period. EPA may modify the preferred alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on <u>all</u> the alternatives presented in this Proposed Plan.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, 42 U.S.C Section 9617, commonly known as Superfund, and Section 300.430 (f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This Proposed Plan summarizes information from the site Remedial Investigation (RI) and Focused Feasibility Study (FFS) reports and other documents that comprise the site Administrative Record. EPA encourages the public to review the Administrative Record to gain a more comprehensive understanding of the cleanup and investigative activities that have been conducted at the site.

II. SITE BACKGROUND

Site Location and Description

The nearly 23-acre NSG Former South Plant MGP Superfund site includes the 1.9-acre former South Plant MGP parcel located at 2 North Pershing Road and 1 South Pershing Road in Waukegan (see Figure 1), and several adjacent properties where MGP-derived contaminants have been found (see Figure 2). The adjacent parcels include:

- Waukegan Port District (WPD)-owned property located to the east of the former MGP parcel on Lake Michigan. The 13.1-acre WPD parcel includes a marina, a visitor center/administration building, a maintenance building, and asphalt-paved parking lots.

- Akzo Nobel Aerospace Coatings, Inc. (Akzo) parcel located east/southeast of the former MGP and adjacent to Lake Michigan. The 6.2-acre property consists of buildings used for manufacturing paints and coatings and asphalt-paved parking lots.

- Elgin, Joliet and Eastern (EJ&E) railroad tracks and right-of-way located east and at the south end of the former MGP property. This parcel is approximately 0.7 acres.

- City of Waukegan-owned parcels located southeast of the former MGP site between the EJ&E, Akzo, and WPD properties. One parcel is a vacated former city street that abuts a ComEd substation and others include nearby roads and associated right-of-ways, totaling 0.5 acres.

The Former South Plant MGP property is bounded to the north by a city-owned Metra train parking lot and to the west by a Union Pacific Railroad train yard. There are no known MGP residuals on these properties and both are upgradient of the former MGP site based on the localized groundwater flow direction. South Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the former MGP property. South Waukegan Harbor was constructed in the mid-1980s as a marina for recreational boats and has a southern exit to Lake Michigan. The Waukegan River is located approximately 1,000 feet south of the former MGP property and flows east past the Akzo property into Lake Michigan.

Site History

MGPs were industrial facilities that were found in every sizable town or city in the U.S. from the 1820s to right after World War II. MGPs heated coal in large industrial ovens to produce manufactured gas used for street lighting, heating, and cooking. After the war, natural gas use replaced manufactured gas use because it was abundant, lower priced, and cleaner burning. Some MGPs continued to operate after the war, but most ceased operations by the 1960s and were torn down. Typically, the above-ground structures, such as buildings, tar/oil tanks, and storage sheds, were demolished and the foundations were backfilled, leaving hardly any visible traces of the former operations. Below-ground structures such as underground piping and storage tanks, along with residual contaminants, were often left behind.

Figure 1: NSG Former South Plant Former MGP site location

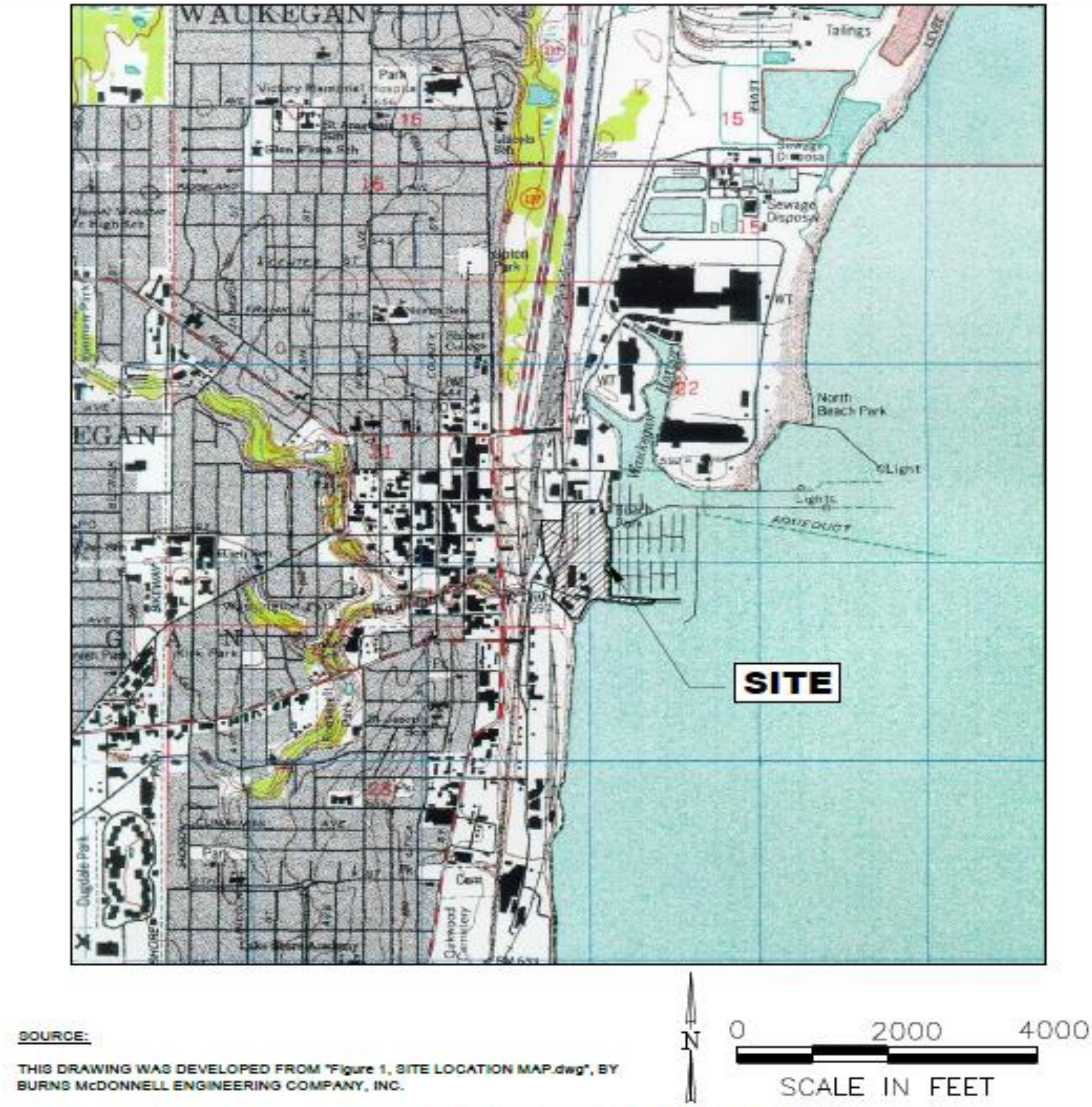
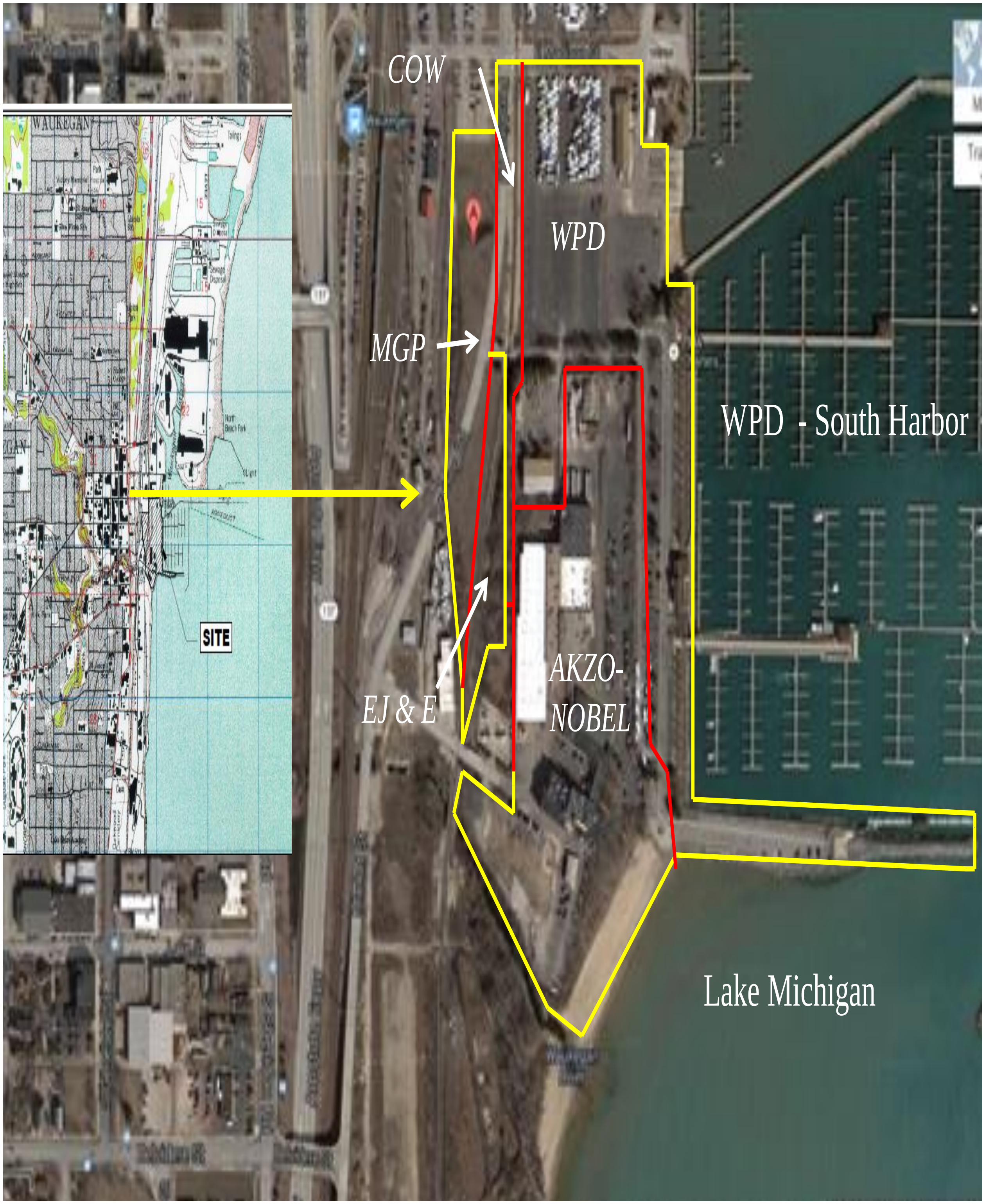


Figure 2: NSG South Plant Former MGP site property boundaries



The Waukegan Pipeline Service Company constructed the original South Plant MGP in 1897 and the Waukegan Gas, Light, and Fuel Company purchased it in 1898. NSG purchased the facility in 1900 and leased the southern 0.37 acres from the EJ&E Railroad. Aerial surveys and available information indicate that this facility was comprised of three gas holders ranging in capacity from 60,000 to 518,000 cubic feet; an office building with a storage room; a coal shed; boilers; oil and tar tanks; an engine house; ammonia stills; and a generator house. The South Plant MGP operated on a full time basis from 1898 to 1927. NSG shut it down in 1927 but later operated it as a peak production unit during high demand periods between 1935 and 1946 (see Figure 3). NSG permanently closed the South Plant MGP in 1946 and demolished it in 1951.

Contaminants and Media Affected

The South Plant MGP generated various by-products and wastes, such as coal tar, ammonia, cyanide, ammonium sulfate, sulfur, wastewater sludges, ash, and tar/oil emulsions. These materials contain polynuclear aromatic hydrocarbons (PAHs) such as naphthalene and benzo(a)pyrene; petroleum hydrocarbons such as benzene, toluene, ethylbenzene, and xylene (BTEX); metals such as arsenic and lead; cyanide; and phenolic compounds. Varying levels of these contaminants have been found in the site soil, groundwater, and adjacent surface water and sediment samples.

This Proposed Plan addresses the pool of tar-like free-phase product (the DNAPL) found below the site. NAPLs are comprised of liquids that do not readily mix with water, such as gasoline or coal tar, although the compounds may also partially dissolve in water. Chemicals that are denser than water, such as coal tar, create DNAPLs because they tend to sink to the bottom of the groundwater column. Products such as gasoline, which is less dense than water, create light nonaqueous phase liquids (LNAPLs) that float at the top of the water table. The DNAPL found at the South Plant MGP site is the main source of the groundwater contamination.

Early Environmental Investigations and Response Actions

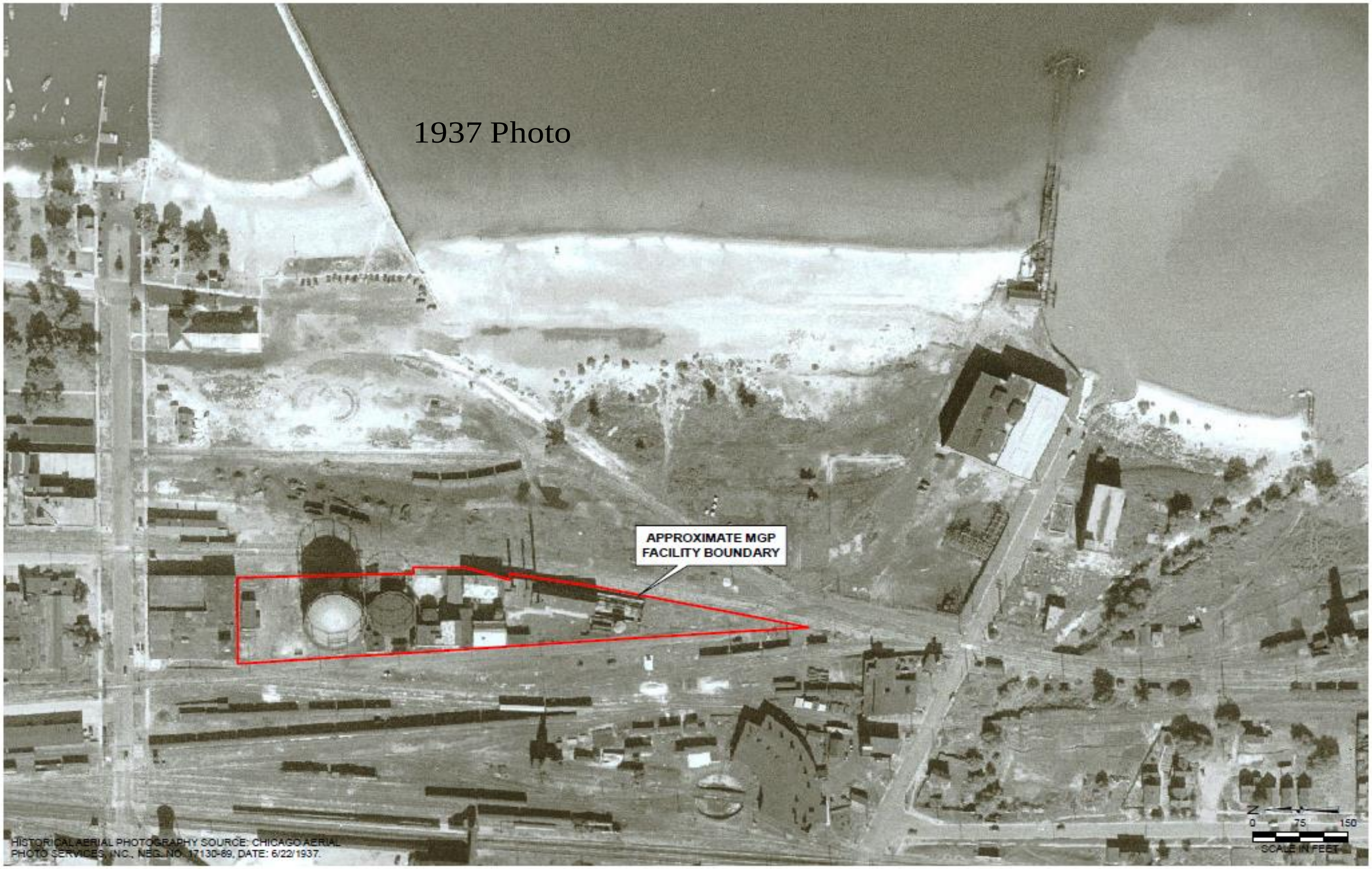
NSG has conducted contaminant investigations and cleanup activities at the South Plant MGP site since the early 1990s. Most of these pre-CERCLA cleanup actions were conducted in accordance with Illinois' voluntary Site Remediation Program (SRP). The investigations focused on identifying sources of MGP residuals and evaluating soil and groundwater conditions. NSG dug test pits, took soil borings, and installed groundwater monitoring wells. Groundwater and soil samples were analyzed for a variety of chemicals of potential concern (COPC). NSG also worked to delineate the extent of the groundwater contaminant plume and the DNAPL pool.

Environmental Investigations

Illinois EPA conducted a Preliminary Site Inspection in September 1991 and a Screening Site Inspection (SSI) in November 1991, collecting 11 surface soil samples on the former MGP property as part of the SSI. Based on the preliminary site inspection and the sampling results, Illinois EPA recommended that the South Plant MGP site be placed into the EPA Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and that the site be assigned a medium-priority status. The state issued several reports summarizing these site activities, including:

- CERCLA Preliminary Assessment Report, NSG Plant (Illinois EPA, 1991)
- CERCLA 1992 Screening Site Inspection, NSG Plant (Illinois EPA, 1992)

Figure 3 – Aerial view of South Plant MGP, Waukegan, Illinois



Next, in the early 1990s, NSG conducted a preliminary site investigation to determine the potential environmental impacts of the former MGP contaminants. The preliminary site investigation showed that chemical compounds associated with past MGP activities may be present in subsurface soils. NSG conducted a follow-up site investigation in 1999 to compile and evaluate previously-collected data, evaluate the nature and extent of impacts, and obtain additional data to assess potential health risks at the MGP property. NSG evaluated most of the former MGP parcel, excluding the paved portions (Pershing Road and South Harbor Place), completing eight test trenches and four soil borings (which were converted into temporary piezometers). Soil samples were analyzed for volatile organic compounds (VOCs), PAHs, and total organic carbon (TOC). Groundwater samples were analyzed for VOCs, PAHs, metals, and cyanide. NSG issued several reports summarizing the site investigations, including:

- Preliminary Site Investigation South Plant MGP, Waukegan, IL (Barr Engineering, April 1993)
- Site Investigation Report, Former South Plant MGP (Barr Engineering, June 2002)

Most of the soil samples showed contaminant impacts in the upper 3 feet of the soil column. Impacts from both tar-like and petroleum compounds were suspected to be present in soil and groundwater, with suspected petroleum-like material found at or near the water table.

Between 2002 and 2006, NGS conducted additional investigations on its MGP property and on surrounding properties. These investigations were completed for specific objectives, and are summarized below:

June – Sept. 2002	NGS conducted sampling activities to further delineate the lateral and vertical extent of source material on the MGP property. Analytical results indicated that soil and groundwater samples had high levels of PAHs and BTEX. Source material was observed and characterized as tar-saturated soil and DNAPL. (Supplemental site Investigation Report (Feb. 2003))
July 2003	NSG performed further definition of the extent of suspected source material (based on visual characterization) at the former MGP property. COPCs in soil above the water table included BTEX, PAHs, arsenic, and lead. NSG subsequently proposed to remove the top 3.5 feet of soil across the entire MGP parcel and to remove source material in some locations to the water table (to about 7 feet below ground surface (bgs)). (Report to Illinois EPA, November 2003)
June –Aug. 2003	NSG took samples to delineate the extent of groundwater impacts on the WPD property. Three areas on the WPD property exhibited tar-like DNAPL or tar-saturated soil. These impacts were observed between 6 and 16 feet bgs.
Feb. - March 2004	NSG advanced soil borings and probes on the Akzo property to characterize soils deeper than 10 feet bgs and found MGP- and petroleum-like odors in most locations. (Report to Illinois EPA, March 2004)
May 2004	NSG further sampled groundwater under the WPD property, identifying areas characterized as having tar-like DNAPL or tar-saturated soil on the southeast corner of the boat parking lot and the northwest corner of the visitor parking lot.

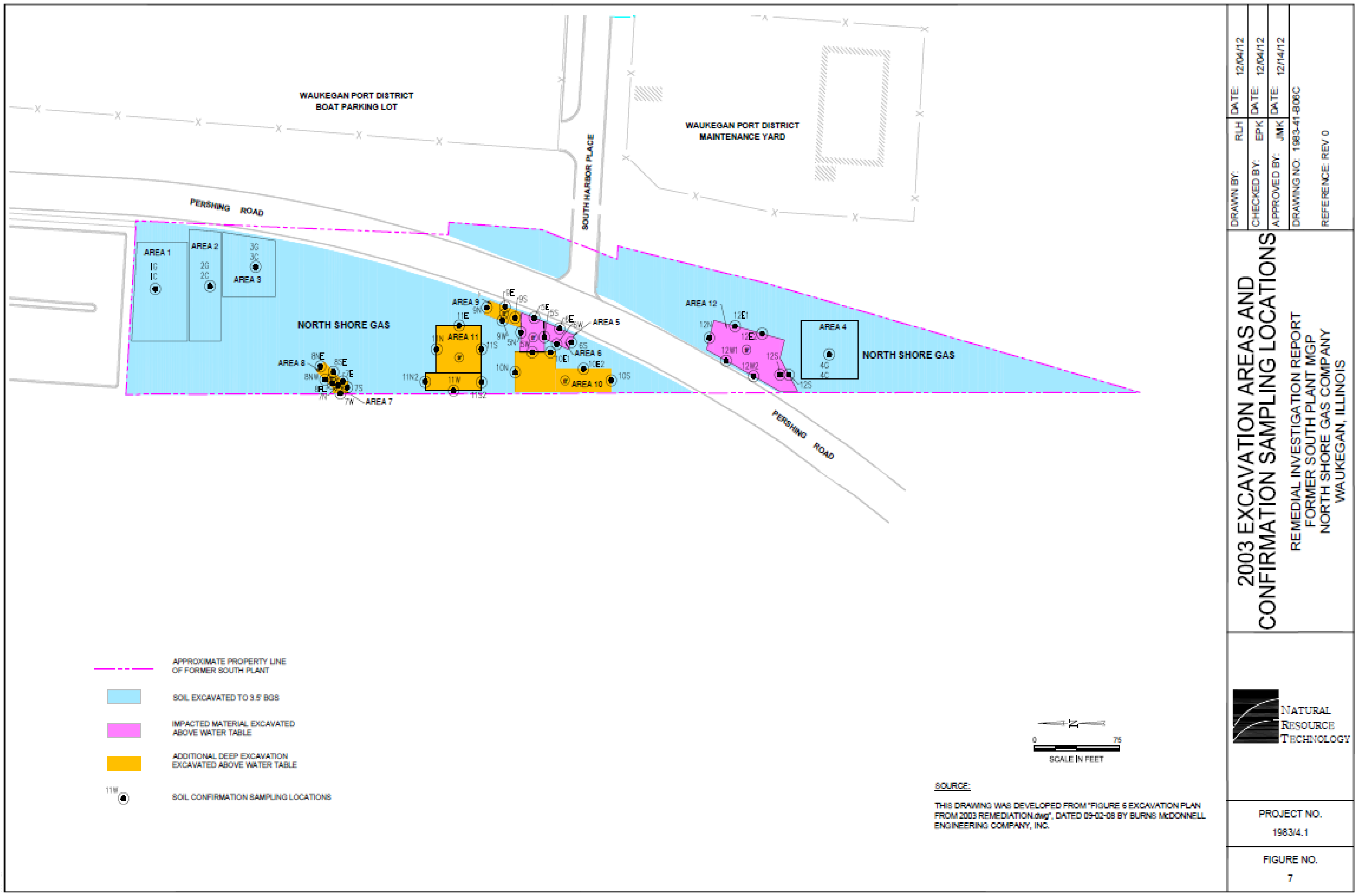
These impacts were observed between 6 and 22 feet bgs. (Report to Illinois EPA, July 2005)

May 2005	NSG conducted a ground-penetrating radar survey to determine whether former MGP structures were beneath Pershing Road and identified potential subsurface features and anomalies. (Report to Illinois EPA, July 2005)
May – Aug. 2005	NSG completed groundwater investigation activities on the MGP and WPD properties. The objective was to obtain groundwater data for both properties during a single sampling event. Additional groundwater monitoring wells were installed, bringing the total to 60 (42 on the MGP and 18 on the WPD properties) to date. Nine 6-inch diameter DNAPL recovery wells were also installed on the former MGP and WPD property to the east. WPD property wells installed to the east are located in the boat parking lot, the maintenance building parking area, and the Administration building parking lot. (Report to Illinois EPA, August 2007)
Aug. 2005	NSG conducted a DNAPL investigation on the MGP and WPD properties and installed additional groundwater monitoring wells and took soil samples for forensic analysis. Results indicated that petroleum hydrocarbons are present, but the majority of impacts on the WPD property are MGP-related.
Dec. 2005	NSG collected five soil gas samples from a depth of approximately 4.7 to 5 feet bgs in the vicinity of the WPD maintenance building. Evaluation of the soil gas results using the Johnson and Ettinger Model (EPA 1991) indicated a low risk potential for vapor intrusion to indoor air within the WPD maintenance building. (Report to Illinois EPA, June 2006)
Sept. 2006	NSG completed a second round of groundwater sampling to again obtain water quality data from the MGP and WPD properties during a single sampling event. Samples were collected from 67 of the now 87 monitoring wells. (Report to Illinois EPA, September 2007)

Early Response Actions

Between December 2003 and February 2004, NSG excavated soil down to the depth of groundwater (3.5 to 7 feet bgs) on the former MGP property and disposed of it off-site as part of a focused remediation effort. Excavation of the top 3.5 feet of soil across the entire property was completed along with deeper excavation of suspected source material areas in certain areas. Material removed from excavated areas consisted of fill, soil, suspected source material (characterized as tar-impacted fill/soil), piping, and debris. After successful removal of suspected source material, confirmation sampling indicated impacted material above the water table was removed satisfactorily, except under the Pershing Road right-of-way and along the west property boundary (see Figure 4). NSG then installed a plastic liner in the excavations and backfilled them with clean soil. NSG also installed plastic liners along the sidewalls of excavations next to Pershing Road and along the western property line to help prevent residual contaminants from moving into the clean imported backfill. NSG disposed of about 19,223 tons of excavated material as nonhazardous special waste at a nearby licensed landfill. (Report to Illinois EPA, March 2005)

Figure 4: Previous Response Action at NSG South Plant Former MGP (Dec. 2003 – February 2004)



DNAPL Recovery

NSG began DNAPL recovery from 19 vertical extraction wells located on the former MGP and WPD properties in April 2006 and its DNAPL recovery efforts continue to this day. During recovery operations, the DNAPL is pumped from the wells into Department of Transportation (DOT)-approved steel drums, which are then sealed, labeled, manifested, and transported to a facility in Houston, Texas, where the DNAPL is blended as fuel to be used by local cement kilns. From April 2006 to May 2007, NSG pumped DNAPL from the wells at approximate 3-week intervals, moving to six-week intervals from May 2007 to the present. As of January 2015, approximately 1,370 gallons of DNAPL have been recovered. The DNAPL recovery wells located in the WPD Administration building parking lot and boat parking lot have accounted for almost 80 percent of the DNAPL recovered to-date.

Remedial Investigation/Feasibility Study

In July 2007, EPA and NSG entered into an Administrative Order on Consent (AOC) that required NSG to conduct a Remedial Investigation/Feasibility Study (RI/FS) at both the South Plant and the North Plant former MGP sites in Waukegan (Docket No. V-W-07-C-877). Integrys Business Support, LLC (Integrys), which was formed in 2007 with the merger of NSG and other area utilities, performed the RI/FS under the AOC, with EPA oversight. The RI report was approved by EPA on January 22, 2014, and the Focused FS (FFS) report to address the DNAPL was approved by the agency on April 9, 2015. EPA has placed both reports, including supporting documentation, in the site's Administrative Record.

III. SITE CHARACTERISTICS

Regional Setting

The NSG South Plant MGP site is located in Waukegan, Lake County, Illinois along the western shore of Lake Michigan (see Figure 1). The population of Waukegan is approximately 89,000, based on the 2010 U.S. Census Bureau data. The surrounding area is generally flat, with a mean sea elevation of approximately 597 feet above sea level. The climate in the area is typically continental, with some modification by Lake Michigan. Average monthly temperatures range from about 21ºF in January to about 73ºF in July. The ground surface around the site consists of grassy vegetation, buildings, and asphalt-paved parking lots and roads. The site is not located within the 100-year floodplain.

The MGP property is currently zoned as commercial/recreational, while the WPD, Akzo, EJ&E, and City of Waukegan parcels are zoned general industrial. The city's Lakefront Downtown Master Plan (July 2003) called for the MGP site area to be developed into mixed-use property with marina-related services, retail, residential, and open space. This master plan has not been implemented at this time.

No municipal or private drinking water wells are located at the site or within a one-mile radius of the site. The City of Waukegan obtains its municipal water supply from Lake Michigan. By ordinance, water wells in the county are not permitted in areas where a public water supply is available. In cases where a public water supply is not available, potable water wells may only be permitted after approval from the county health department.

Site Geography and Geology

South Waukegan Harbor and Lake Michigan are located approximately 600 feet east of the South Plant MGP property. The Waukegan River, located approximately 1,000 feet south of the South Plant MGP, flows east past the Akzo parcel into Lake Michigan and drains a 12 square mile watershed area. The watershed is highly urbanized, containing only 13% undisturbed land, and lack of a natural floodplain area has limited expansion of flow in the Waukegan River, causing erosion to occur in the channel itself. Currently, few storm water detention basins exist and bank erosion in the area is a direct cause of sedimentation into Lake Michigan. Erosion in the channel releases urban contaminants that affect the water and sediment quality in the river and at its mouth. However, it is unlikely the river influences Lake Michigan currents for any more than the briefest periods during large storm events.

The shallow groundwater in the Waukegan area is generally limited to sand and gravel horizons in unconsolidated soil and in fractured bedrock aquifers. The unconsolidated materials in the site area consist primarily of clay with isolated lenses of sand and are not considered productive aquifers. Recharge to the aquifers is primarily by precipitation and infiltration.

The geology encountered beneath the site is composed of a sand/silty sand layer from the surface to an average depth of 15 feet underlain by a clay layer.

The following stratigraphic units are found at the site:

- Fill – Primarily sand with lesser amounts of gravel, slag, and wood fragments. Thickness ranges from 2 feet on the west side of the site to 20 feet adjacent to Waukegan Harbor. In paved areas, the fill includes approximately 3 inches of asphalt and up to 8 inches of sub-base.

- Sand Unit – Primarily natural fine-grained silty sand of alluvial origin. The top of the sand unit was encountered from 1 to 4 feet bgs, with an average thickness of approximately 14 feet.

- Clay Unit – Primarily very stiff to hard, low plasticity silty clay. Top of clay was encountered at depths ranging from 14 to 18 feet bgs across the majority of the site but was present as shallow as 4.5 to 6 feet bgs in the vicinity of the Waukegan River.

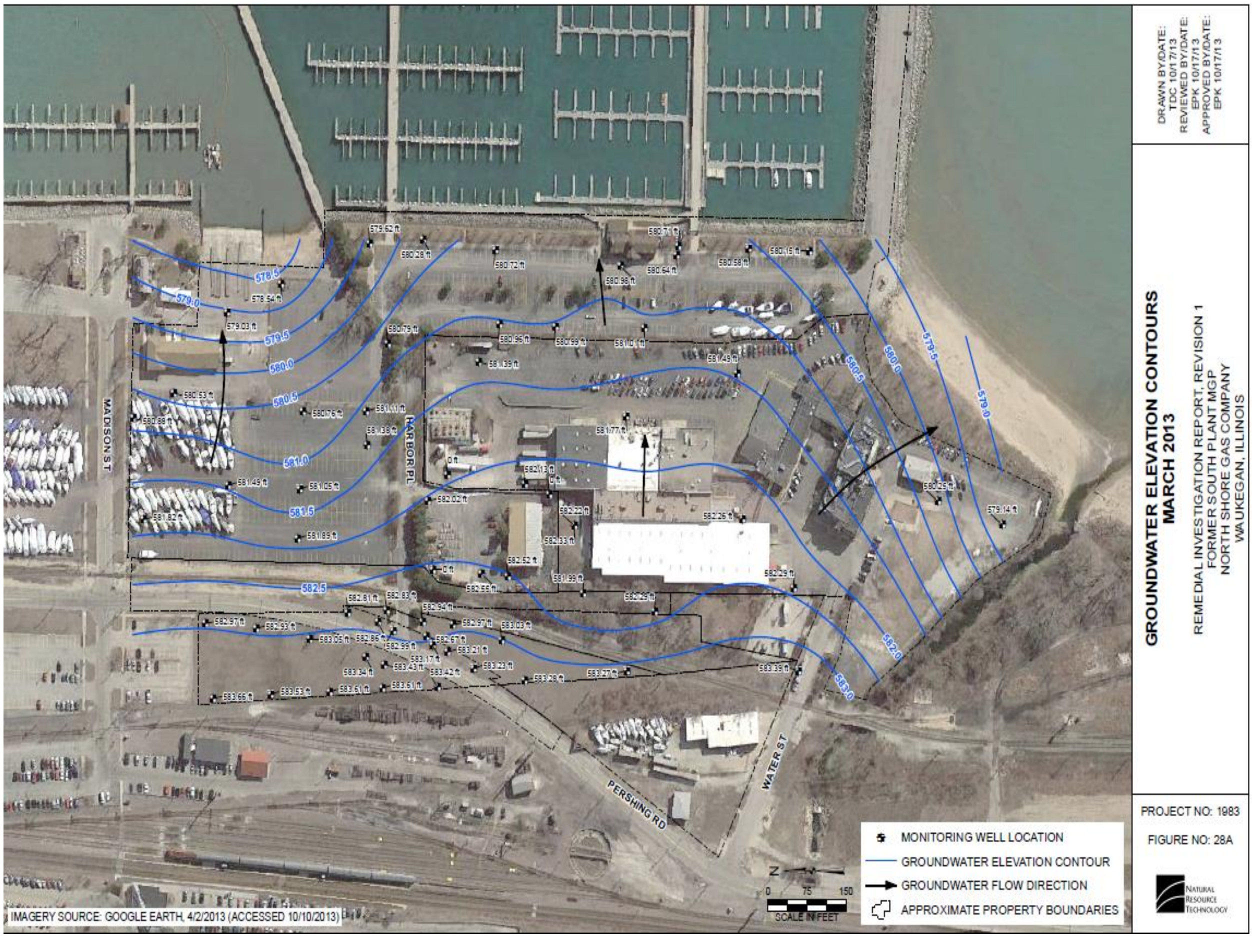
The sand unit is the main water-bearing unit at the site. Shallow groundwater is encountered at about 7 feet below ground surface (bgs) and groundwater contours indicate an easterly flow toward Lake Michigan. Subsequent groundwater flow measurements beginning in November 2009 continue to indicate this easterly flow direction (see Figure 5).

Cultural and Natural Resource Features

Illinois Department of Conservation's Natural Heritage Database lists no federal or state threatened and endangered species or pristine natural areas located on the site. The U.S. Fish and Wildlife Service (FWS) did identify the federally endangered Piping Plover, a migratory bird, as having a critical habitat approximately ½ miles northeast of the site. The North and South Harbor marinas, located adjacent and east of the site, are used by recreational boaters during the boating season from about April 1 to November 1. Beach Park is located adjacent to the North

Harbor Marina and North Beach Park is located about 0.5 miles northeast of the site along Lake Michigan.

Figure 5 - Groundwater Flow



Nature and Extent of DNAPL Contamination

The RI found that DNAPL was a continuing source of contamination to the groundwater and that two distinct zones of DNAPL impacts were present at the site. The first zone was a 150-ft wide DNAPL plume that radiates from the north side of the former MGP facility, following a localized depression in the confining clay layer and extending to the northeast, under South Harbor Place Drive, into the southwest corner of the WPD parking lot. The second zone of DNAPL impact radiates to the southeast of the former MGP where the plume is approximately 200 feet wide, underneath the WPD maintenance building and the Akzo facility to a localized depression in the confining clay layer located west of the WPD Administration Building, where the plume is approximately 425 feet wide. NSG calculated in the FFS report that the overall areal extent of the DNAPL plume is 278,600 square feet (roughly 6 acres), with an estimated total volume of 527,000 gallons of tar-like material (see Figure 6).

Principal Threat Waste

The DNAPL is a continuing source of groundwater contamination at the site and represents a principal threat waste that needs to be addressed, preferably by treatment, due to its toxicity and volume.

IV. SCOPE AND ROLE OF THIS ACTION

This Proposed Plan consists of an interim action that only addresses the DNAPL underneath the site. Once the DNAPL remedial action is completed, EPA will prepare a second Proposed Plan for a final remedy to address the remaining media of concern (soil, soil vapor, and groundwater) at the site. EPA's preferred alternative will remove DNAPL from beneath the site and transport it off site for treatment and disposal, which would satisfy the preference for treatment of principal threat waste under Superfund policy and law.

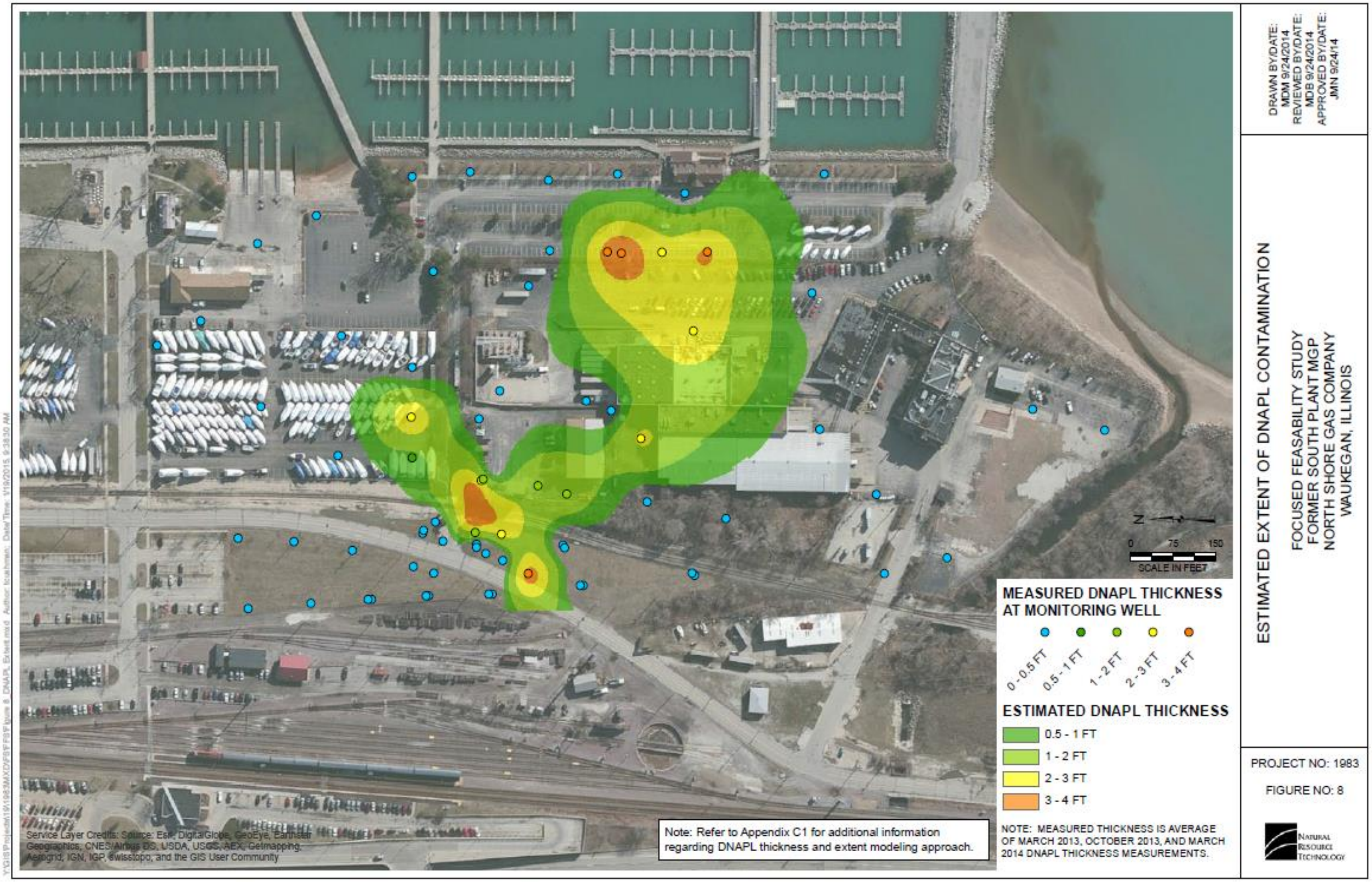
V. SUMMARY OF SITE RISKS

EPA approved the RI report on January 22, 2014. As part of the RI report, Integrys conducted a Baseline Risk Assessment (BLRA), which evaluated the potential for human health and ecological risks associated with site contaminants. The human health risk assessment (HHRA) component of the BLRA addressed potential risks to people from contaminated soil and groundwater in the terrestrial (upland) portion of the site, along with potential exposures to contaminants in the surface water and sediments at the site (at the marina, beach, and in Lake Michigan). However, the ecological risk assessment (ERA) only focused on the water bodies adjacent to the site because EPA determined that the site itself did not contain terrestrial habitat requiring an ecological risk evaluation.

Chemicals of Concern (COCs)

As stated above, the site DNAPL is a continuing source of contamination to area groundwater. Primary COCs in the site groundwater contaminant plume include PAHs such as naphthalene and benzo(a)pyrene; BTEX compounds; and metals such as arsenic and lead.

Figure 6: Estimated Extent of DNAPL Contamination



Human Health Risk Assessment

EPA calculates the probability of non-carcinogenic (not cancer-causing) and carcinogenic (cancer-causing) health effects due to human exposure to site contaminants in human health risk assessments. For noncarcinogenic chemicals, EPA calculates a hazard quotient (HQ) for each COC. The HQ is the ratio of the estimated exposure level to a chemical compound over a specified period of time to a reference dose of the same substance that may cause deleterious health effects over the same exposure period. EPA recommends that the HQ for exposure to a COC at a site be limited to 1 or less, which signifies that the exposure level at the site would be below that which would cause an adverse human health effect. For carcinogenic health risks, EPA calculates the estimated lifetime cancer risk (ELCR) due to exposure to carcinogenic chemicals at a site. EPA recommends that site cleanups achieve a target ELCR range of one in one million ($1x10^{-6}$) to one in ten thousand ($1x10^{-4}$).

The area around the South Plant MGP site is currently zoned for industrial, commercial, and recreational uses, with the potential for residential use if the city's master plan is implemented. Thus, human health risks at the site were assessed for both commercial/industrial (current) and residential (future) receptors. Each scenario was evaluated against potential exposure pathways, as summarized in the following table:

Receptor	Exposure Pathways
Industrial or commercial worker	Incidental ingestion, dermal contact, vapor intrusion, and inhalation of DNAPL-affected soil (as a result of soil disturbance)
Construction worker	Incidental ingestion/dermal contact/inhalation of DNAPL-affected soils (as a result of soil disturbance), and groundwater, surface water, and sediment via dermal contact and inhalation
Recreational visitor	Incidental ingestion of surface water and sediment/dermal contact with surface water and sediment potentially impacted by DNAPL
Resident (future use)	Incidental soil ingestion/dermal contact/inhalation (including vapor intrusion from DNAPL-impacted subsurface soil and groundwater)

Human Health Risk Characterization

The DNAPL is primarily a source of contamination in site soil, groundwater, and soil gas rather than a direct health risk itself; thus, a comprehensive human health risk assessment specific to DNAPL was not completed. The BLRA did evaluate exposure pathways to DNAPL as part of the evaluation of potential health risks due to COCs in soil, groundwater, and soil vapor. A summary of some of these exposure pathways is included below:

Groundwater: Exposure to groundwater in construction excavations in each area of the site could potentially be associated with unacceptable risks because DNAPL is present near or below the water table in one or more wells. However, only construction workers having direct exposure to groundwater or inhaling vapors in excavations at or below the water table (as shallow as 3–5 feet bgs but typically averaging between 6.5 to 8.5 feet bgs) would be at potential risk. The potential for exposure of construction workers to groundwater in excavations is likely limited due to safety considerations other than those related to DNAPL exposure. However, because exposure to groundwater containing DNAPL or associated vapors is assumed to present unacceptable risks to construction workers, appropriate steps should be taken to prevent such exposure.

Surface Soil: There are very few areas of the site where surface soils are both exposed and where residual DNAPL-like contaminants are present. Most surface soils are either clean soils that have been imported after remediation was completed or are located below pavement preventing human exposure. There are some areas on the AKZO property where surface soils are not under pavement (areas with ornamental trees), but these areas are not near the former MGP parcel and are not expected to have been impacted by the former MGP activities.

Soil Vapor: The potential vapor intrusion exposure pathway was evaluated using soil vapor samples taken at depths ranging from 3.5 to 5 feet bgs, with sub-slab samples taken at 1 foot bgs. Potential impacts were found and are associated with dissolved chemical levels in groundwater rather than the DNAPL itself.

Conclusions from the HHRA

The following conclusions were made in the HHRA:

- DNAPL is a continuing source of groundwater contamination. The groundwater does not meet drinking-water standards in any of the areas evaluated, and it should not be used for that purpose. Estimated risks would exceed the risk management range under a residential tap water scenario for all areas.

- Because of the presence of DNAPL in one or more wells on each site parcel, construction worker exposures to subsurface soils, groundwater, and soil vapor on each property should be assumed to be associated with the potential for unacceptable risks if intrusive construction activities occur in the future.

- Potential vapor intrusion risks are present (under the residential or industrial scenarios) at the AKZO and WPD parcels. Health risks for the AKZO area are within the risk management range for current (industrial) use. For future residential use, ELCRs were within or at the high end of the risk management range but HQ values were greater than 1. For the WPD area, risks were at the upper end of the risk management range for current industrial use, and above the risk management range for future potential residential use.

Ecological Risk Assessment

The BLRA evaluated the ecological risks at the site and concluded that the upland area does not support habitat for ecological receptors due to the developed nature of the properties, consistent with the commercial/industrial zoning of the land. The BLRA also concluded that the nature and concentration of the COCs detected in surface water and sediment in the marina, Lake Beach, and open-water environment is not expected to pose an ecological concern. Potential risks associated with future DNAPL that could potentially discharge into the marina will be addressed through upland DNAPL management.

Basis for Taking Action

It is EPA's current judgment that the preferred alternative identified in this Proposed Plan is necessary to protect human health and the environment from actual or threatened releases of contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

VI. REMEDIAL ACTION OBJECTIVE FOR DNAPL

EPA developed the following Remedial Action Objective (RAO) to protect the public and the environment from potential health risks posed by DNAPL at the site:

- Reduce the mass and mobility of recoverable DNAPL to the extent practicable

VII. SUMMARY OF DNAPL REMEDIAL ALTERNATIVES

The DNAPL remedial alternatives evaluated in the FFS are summarized below:

- D1 - No Action
- D2 - Institutional Controls
- D3 - Vertical Engineered Barrier
- D4 - Horizontal Well DNAPL Recovery
- D5 – Physically-Enhanced DNAPL Recovery
- D6 – Chemically-Enhanced DNAPL Recovery
- D7 – Thermally-Enhanced Recovery

The Preferred Alternative is Alternative D5 - Physically-Enhanced DNAPL Recovery (see Figure 7). The Illinois EPA expressed preference for this alternative in its March 31, 2015 comment letter to EPA.

Description of DNAPL Remedial Alternatives

DI – No Action

Under the No Action alternative, EPA would take no further actions to address potential exposure to the tar-like DNAPL at the site or to address the DNAPL as a continual source of groundwater and potentially surface water contamination. The No Action alternative is included in the list of DNAPL alternatives evaluated in the FFS to be consistent with the NCP and it is used as a baseline for comparisons to the other DNAPL alternatives.

D2 – Institutional Controls

Under Alternative D2, EPA would place institutional controls (ICs) on the site to minimize exposure to DNAPL. ICs would consist of both administrative and legal controls. Since the primary mechanism for human exposure to DNAPL would be though consumption of groundwater contaminated by DNAPL, Alternative D2 would place ICs on the site parcels to restrict the use of groundwater as a drinking water source until drinking water standards are met. The ICs would also require worker cautions as well as health and safety planning to protect potential future construction workers from exposure to DNAPL compounds in the groundwater.

Groundwater ICs would best be a combination of a local ordinance enacted by the Waukegan City Council creating a restricted groundwater use zone that prohibits the use of DNAPL-impacted groundwater as a potable water supply and the placement of a Uniform Environmental Covenant (under 765 ILCS Chapter 22) on the site parcels to provide additional assurances that the IC will continue to be enforced in the event of property transfer or changes in future land use. An IC Implementation Plan would be developed to detail groundwater-use restrictions and document procedures for effectively implementing the ICs. Because no actions would be taken to reduce the mass or mobility of the DNAPL and site contamination above health-based limits would be left onsite, EPA would need to conduct a FYR every five years at the site.

D3 – Vertical Engineered Barrier

Under Alternative D3, EPA would install a low-permeability vertical engineered barrier around the DNAPL plume. Vertical barriers are typically constructed with soil-bentonite (“slurry wall”), high-density polyethylene (HDPE), or steel sheet piles. The vertical engineered barrier would be keyed into the underlying confining clay layer a minimum of 3 feet. The confining clay layer would limit downward migration of DNAPL and the low permeability vertical engineered barrier would limit the lateral migration of DNAPL. The engineered barrier would contain both the groundwater and DNAPL, thereby reducing mobility of DNAPL compounds in partial accordance with the RAO. Because no additional actions would be taken to reduce the mass of the DNAPL and site contamination above health-based limits would be left onsite, EPA would need to conduct a FYR every five years at the site.

D4 – Horizontal Well DNAPL Recovery

A network of vertical DNAPL recovery wells is currently being operated at the site. However, these wells have removed a limited volume of DNAPL since initial operations began in 2006. Under Alternative D4, a network of horizontal recovery wells would be installed above the clay-confining layer at site locations that are within and downgradient of accumulated DNAPL. DNAPL would pass through the horizontal well screen and flow via gravity within the sloped horizontal well to a collection sump. Then, the DNAPL would be pumped into collection containers for off-site treatment and disposal.

Compared to the existing vertical DNAPL recovery wells, the horizontal DNPAL recovery wells will have a significantly greater screened interval within the DNAPL bearing zone and will thus be much more effective at recovering DNAPL, although it is estimated that DNAPL recovery would occur over a 30-year period before the mass and mobility is reduced to the extent practicable.

Three primary horizontal well installation methods were evaluated as part of Alternative D4 – traditional trench, one-pass trench, and horizontal directional drilling. The preferred method will be developed during the remedial design phase. Each is briefly described below:

Traditional trench installation would involve an excavator cutting narrow trenches to a depth of approximately 20 feet bgs in the DNAPL areas, placing the horizontal wells into the excavations, placing washed stone over the wells to protect the pipe and locally increase hydraulic conductivity, and then backfilling the excavations with clean soil or fill. This method would require saw cutting of and removal of pavement along well alignments and the use of trench boxes or a slurry wall to prevent collapse of the sandy soil during installation. While potentially implementable at this site, traditional trench installation is better suited for a site with more cohesive soil, a depth of excavation shallower than groundwater, minimal surface improvements (e.g., pavement), and minimal subsurface utility crossings.

The **one-pass trenching** technique uses a specialized trenching machine that simultaneously removes soil, installs perforated pipe, and places granular backfill into the excavation. The simultaneous installation avoids the need for trench stabilization. One-pass trenching can achieve depths up to 30 feet bgs. Similar to the traditional trench method, the one-pass method requires saw cutting and removal of pavement along the proposed trench alignment. Also similar to the traditional trench method, the one-pass method typically includes backfilling the trench with washed stone. While potentially implementable at this site, one-pass trenching is better suited for sites with minimal surface improvements (e.g., pavement) and minimal subsurface utility crossings.

Horizontal directional drilling (HDD) is a trenchless horizontal well installation method. The equipment and procedures are intended to minimize temporary operational disruption, surface damage, and restoration. Surface impacts are limited to two work areas, one on the entry side and one on the exit side. Horizontal and vertical control of the HDD drill bit between the entry and exit side is performed using magnetic steering tools in conjunction with a surface monitoring system. The locator provides information to the operator to allow real-time path corrections to follow the planned bore path. Some systems directly transmit the location information to a display on the drill rig to automatically control the drill path.

Some unique advantages of horizontal drilling include: minimal site preparation and restoration costs because disturbance is limited to entry and exit points; comparatively easy utility crossings; and reduced soil management and disposal volumes. Some unique disadvantages include: limited effectiveness in drilling through stone and cobbles and reliance on the permeability of the surrounding soil rather than installation of a high permeability granular backfill. Due to the discrete land disturbance associated with pipe installation using HDD, installation does not allow backfill around the pipe. Therefore, the pipe will be in direct contact with the subsurface soil and subject to potential pipe clogging, particularly if installed in soil containing a significant fraction of fine material. There is also some uncertainty regarding the effectiveness of a horizontal well system due to possible stratification of subsurface soil; whereas trenching overcomes stratified soil layers by cutting through the soil profile.

EPA would still need to conduct a FYR every five years at the site as long as contamination above health-based limits remain at the site.

D5 – Physically-Enhanced DNAPL Recovery

Under Alternative D5, EPA would physically enhance DNAPL recovery efforts through the use of simultaneous groundwater extraction and injection. Groundwater injection will locally increase hydraulic gradients, thereby increasing the rate of DNAPL migration toward recovery wells. Alternative D5 would involve installation of both injection and extraction wells, as well as a phase-separation and groundwater treatment facility. It is estimated that DNAPL recovery would occur over a 7-year period before the mass and mobility is reduced to the extent practicable.

Physically-enhanced recovery can be performed using a variety of methods and can be implemented using horizontal or vertical wells. Two primary approaches, separate-phase extraction and multi-phase extraction, are described below:

Separate-phase extraction would use dedicated DNAPL and dedicated groundwater extraction pumps in a single vertical well. A low-flow DNAPL recovery pump would be placed at the bottom of the well in the DNAPL zone and a standard groundwater pump would be installed above the DNAPL-bearing interval. The groundwater pump would extract a limited volume of DNAPL, which would be removed by a phase-separation unit. The collected DNAPL would be sent off site for treatment and disposal and extracted groundwater would be treated on site prior to re-injection into the ground. Alternatively, extraction could occur in separate but collocated wells. Separate-phase extraction is most applicable to sites with relatively thick accumulations of DNAPL, such as at this site.

Multi-phase extraction would use a single pump in each well to simultaneously remove DNAPL and groundwater. The DNAPL/water mixture would be run through a phase-separator to collect DNAPL for off-site treatment and disposal and extracted groundwater would be treated on site prior to re-injection into the ground. Because the DNAPL would be emulsified in the extracted water, phase separation would be comparatively more challenging and may result in a higher percentage of water remaining in the separated DNAPL. The increased water content will make DNAPL treatment more challenging. Multi-phase extraction is most applicable for sites with relatively thin accumulations of DNAPL, which is not typical at this site.

EPA would need to conduct a FYR every five years at the site as long as contamination above health-based limits remain at the site.

D6 – Chemically-Enhanced DNAPL Recovery

Under Alternative D6, EPA would enhance DNAPL recovery using injection of chemical surfactants. The mobilized DNAPL would be recovered using the extraction techniques similar to those described in Alternative D5. Therefore, implementation of Option D6 will involve installation of both injection and extraction wells, as well as a phase-separation and groundwater treatment facility. It is estimated that DNAPL recovery would occur over a 4-year period before the mass and mobility is reduced to the extent practicable.

Typically, chemically enhanced DNAPL recovery is performed using surfactants and there are several varieties available for the remediation and oil recovery markets. Surfactant injections are often amended with electrolytes, polymers, co-solvents, or oxidants to further increase surfactant effectiveness. Laboratory bench-scale studies are critical to select the proper type and concentration of surfactant and amendment.

Surfactants are only effective at enhancing the recoverability when in direct contact with DNAPL. As a result, having an accurate understanding of the DNAPL plume and the subsurface geology and geochemistry is critical to determining injection zones, well spacing, chemical volume, and other criteria. Application can be performed using either horizontal or vertical wells and DNAPL recovery can either be performed in the same well used for chemical injection or in a separate, downgradient recovery well. Introducing chemicals to the subsurface that may not be recovered is a concern with this alternative.

EPA would still need to conduct a FYR every five years at the site as long as contamination above health-based limits remain at the site.

D7 – Thermally-Enhanced Recovery

Under Alternative D7, EPA would increase the temperature of the subsurface to enhance DNAPL recovery or even to thermally destroy the DNAPL in place. It is estimated that DNAPL recovery would occur over a 4-year period before the mass and mobility is reduced to the extent practicable.

Typical thermal treatment technologies include steam-enhanced extraction, electric resistance heating (ERH), and conductive heating. Each type of thermal treatment technology, as it applies to recovery of DNAPL, is summarized below:

Steam-enhanced extraction would use steam injected under pressure into the DNAPL zone through injection wells, which increases the subsurface temperature and causes the DNAPL to mobilize and be displaced. The DNAPL can then be recovered using multi-phase extraction wells. The more volatile DNAPL constituents, e.g., BTEX and naphthalene, would also be volatilized by the increased subsurface temperatures. This method primarily relies on conductive and convective heat transfer to increase subsurface temperatures. As a result, this technology is best suited for soil with moderate to high permeability and limited subsurface obstructions, as is the case for this site. The maximum subsurface temperature is limited by the temperature of the injected steam (about 100 degrees Celsius).

ERH would use an array of subsurface horizontal or vertical electrodes to apply current through the soil and groundwater. Soil moisture conducts electrical current and the soil's natural resistance to the flow of electrical current results in the generation of heat, which causes the DNAPL to mobilize and be displaced. The DNAPL can then be recovered using multi-phase extraction wells. The more volatile DNAPL constituents, e.g., BTEX and naphthalene, would also be volatilized by the increased subsurface temperatures and would need to be collected separately. Heat distribution from ERH is relatively uniform, even in areas of low permeability and the maximum temperature of ERH is generally limited to the boiling point of water (about 100 degrees Celsius).

Conductive heating would use heating elements installed in subsurface wells to increase subsurface temperatures to mobilize and displace the DNAPL. The heat from the elements radiates through the soil by thermal conduction. The DNAPL is recovered by a multi-phase extraction system. As with steam-enhanced extraction, the more volatile DNAPL constituents would be volatilized by the increased subsurface temperatures. Unlike steam-enhanced extraction, thermal conductive heat transfer occurs relatively uniformly throughout a targeted treatment zone, even in areas of low permeability, which is often where DNAPL accumulates. Conductive heating is not limited by the boiling point of water and can achieve temperatures up to 500 degrees Celsius. As a result, conductive heating is able to thermally degrade volatile constituents as well as some PAHs. A range of temperatures can be achieved by varying the power supplied to the conductive heating elements. However, temperatures exceeding the boiling point of water (about 100 degrees Celsius) are only achievable in the unsaturated soil zone.

EPA would still need to conduct a FYR every five years at the site as long as contamination above health-based limits remain at the site.

VIII. EVALUATION OF ALTERNATIVES

EPA uses nine criteria to evaluate remedial alternatives in order to select a remedy (see Table 1).

Table 1: The Nine Criteria

EVALUATION CRSITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Threshold Criteria
1. Overall Protection of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to the public health and the environment through engineering controls, treatment, or ICs**.**
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirement that pertain to the site, or whether a waiver is justified.
Balancing Criteria
3. Long-term Effectiveness and Performance considers the ability of an alternative to maintain protection of human health and the environment over time.
4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as relative availability of goods and services.
7. **Cost** includes estimated capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total of an alternative over time in today's dollar value. Cost estimates are expected to be accurate within a range of +50% to -30%.
Modifying Criteria
8. State Acceptance considers whether the State agrees with EPA's analyses and recommendations, as described in the RI/FS and the Proposed Plan.

9. **Community Acceptance** considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Comparative analysis of DNAPL Remedial Alternatives

This section of the Proposed Plan evaluates the relative performance of each alternative against the nine criteria, noting how each compares to the other alternatives under consideration. A more detailed analysis of the DNAPL alternatives is found in the FFS. Table 2 provides a summary of the comparison of the DNAPL remedial alternatives.

1. Overall Protection of Human Health and the Environment

Alternative D1 (No Action) would not be protective of human health and the environment as the DNAPL would remain relatively unabated as a source of groundwater contamination. Alternative D2 would be protective of human health by using ICs to prevent consumption of contaminated groundwater at the site, but it would not be protective of potential ecological receptors in Lake Michigan because no engineering controls would be used to address migration of DNAPL-contaminated groundwater towards the lake.

Alternative D3 would be protective of human health and the environment because it would contain the DNAPL in place and prevent further migration of DNAPL-contaminated groundwater towards the lake.

Alternatives D4, D5, D6, and D7 would be protective of human health and the environment because DNAPL would be recovered over time and prevent further migration of DNAPL-contaminated groundwater towards the lake.

2. Compliance with ARARs

There are no ARARs that directly apply to implementation of Alternatives D1 and D2. However, neither Alternative D1 nor D2 would result in compliance with chemical-specific groundwater ARARs.

Alternatives D3, D4, D5, D6, and D7 would meet all potential ARARs that would apply to the various technologies.

3. Long-Term Effectiveness and Permanence

Alternative D1 has no ability to maintain effective protectiveness of human health and the environment over time.

Alternative D2 would meet the long-term effectiveness and permanence criterion if effective and enforceable ICs are placed on the site.

Alternative D3 would meet the long-term effectiveness criterion for human health and the environment. Vertical engineered barriers are a well-established, long-term remedy used to contain DNAPL at former MGP sites and can provide protection in excess of 30 years.

Alternatives D4, D5, D6, and D7 would meet the long-term effectiveness and permanence criterion because a large volume of DNAPL would be permanently removed from the environment and treated. Permanent removal and treatment provides for greater long-term protectiveness and permanence than Alternative D3, which is a containment-only remedy. Further, Alternatives D3, D4, D5, D6, and D7 provide greater long-term protection because these alternatives are progressively more aggressive in treating DNAPL.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives D1 and D2 do not reduce the toxicity, mobility, and volume through treatment of DNAPL. Alternative D3 only reduced the mobility of DNAPL by containing it in place, but it provides no treatment to reduce the contaminants' toxicity, mobility, or volume.

Alternatives D4, D5, D6, and D7 will reduce the toxicity, mobility, and volume of DNAPL through treatment, but to varying degrees. Alternatives D5, D6, and D7 are more aggressive treatment methods and are expected to remove more DNAPL from the ground in comparison to Alternative D4.

5. Short-Term Effectiveness

Alternatives D1 and D2 provide no short term risks to workers or the public while being implemented. It is estimated that at least 6 months will be required to obtain necessary permissions to place ICs on the site under Alternative D2.

Alternative D3 would present some short-term risks during implementation and operation and maintenance. It is estimated that 12 months would be required to install the vertical engineered barrier and groundwater gradient control system, which would immediately limit the off-site migration of DNAPL. There is a risk that the community could be exposed to a minimal amount of MGP-residuals during construction via air emissions from exposed contaminated soil, while workers would need to wear standard protective equipment during remedy construction and operation and maintenance (O&M). It is expected that the short-term risks would be effectively managed with health and safety measures.

Alternative D4 would present some short-term risks. It is estimated that 6 months would be required to install the horizontal recovery well and sump system. It is estimated that DNAPL recovery would occur over a 30-year period before the mass and mobility is reduced to the extent practicable. The community could be exposed to a minimal amount of MGP-residuals during construction via air emissions from exposed contaminated soil or DNAPL, while workers would need to wear standard protective equipment during remedy construction and O&M. It is expected that the short-term risks would be effectively managed with health and safety measures.

Alternative D5 would present some short-term risks. It is estimated that 12 months will be required to install the horizontal recovery wells, groundwater injection and extraction wells, install the treatment plant and necessary recovery/power lines. It is estimated that DNAPL recovery would occur over a 7-year period before the mass and mobility is reduced to the extent practicable. The community could be exposed to a minimal amount of MGP-residuals during construction via air emissions from exposed contaminated soil or DNAPL, while workers would need to wear standard protective equipment during remedy construction and O&M. It is expected that the short-term risks would be effectively managed with health and safety measures.

Alternative D6 would present some short-term risks. It is estimated that 12 months will be required to install the horizontal recovery wells, groundwater injection and extraction wells, install the treatment plant, surfactant injection system, and necessary recovery/power lines. It is estimated that DNAPL recovery would occur over a 4-year period before the mass and mobility is reduced to the extent practicable. The community could be exposed to a minimal amount of MGP-residuals during construction via air emissions from exposed contaminated soil or DNAPL, while workers would need to wear standard protective equipment during remedy construction and O&M. It is expected that the short-term risks would be effectively managed with health and safety measures.

Alternative D7 would present some short-term risks. It is estimated that up to 12 months will be required to install the thermally-enhanced recovery systems. It is estimated that DNAPL recovery would occur over a 4-year period before the mass and mobility is reduced to the extent practicable. The community may be exposed to minimal amounts of contaminants due to an increased rate of diffusion of contaminants due to increased subsurface temperatures. This risk will be minimized by not heating underneath occupied buildings and implementing vapor controls. The community could also be exposed to a minimal amount of MGP-residuals during construction via air emissions from exposed contaminated soil or DNAPL, while workers would need to wear standard protective equipment during remedy construction and O&M. It is expected that the short-term risks would be effectively managed with health and safety measures.

6. Implementability

Alternatives D1 and D2 are implementable. Coordination with the various property owners may present some administrative challenges for placement of ICs, but they should not be insurmountable.

Alternative D3 is implementable as vertical barrier walls are easily installed and materials are readily available. Implementation will be challenging due to extensive utility crossings, working adjacent to the railroad, and the need to coordinate with property owners.

Alternative D4 would be implementable as recovery trench alignments and HDD construction methods could be used to minimize or avoid utility and property owner conflicts.

Alternatives D5 and D6 would be implementable, but challenging. Recovery trench alignments and proposed construction methods could be selected to minimize or avoid utility and property owner conflicts. However, pump controls, power, and piping will require connection to a treatment plant proposed to be placed on the MGP parcel. This connection will be completed through directionally drilled borings under the EJ&E railroad tracks, and trenching through the Akzo and WPD properties to the wells. Coordination of directional drilling under EJ&E railroad tracks and trenching through the Akzo and WPD properties are technically implementable, but could be an administrative challenge.

Alternative D7 would be implementable, but even more challenging than Alternatives D5 and D6. Thermally-enhanced extraction is technically implementable; however, there are many implementation challenges. Installation and operation of the thermal system will require careful coordination and access agreements with Akzo and WPD to allow electrode and recovery infrastructure to be installed on these properties. Typically, the electrodes need to be located on a 15-20-foot spacing, so there is limited flexibility to accommodate access restrictions within a desired treatment zone. The limited flexibility to adjust well locations is particularly relevant to active roadways, railroads, and industrial buildings.

Table 2: Summary of DNAPL Remedial Options Compared to Superfund Evaluation Criteria

Evaluation Criteria	**DNAPL Remedial Options**						
	D1- No Action	***D2 – ICs***	***D3 – Vertical Eng. Barrier***	***D4 – Horizontal Well DNAPL Recovery***	***D5 – Physically Enhanced DNAPL Recovery***	***D6 Chemically Enhanced DNAPL Recovery***	***D7- Thermally Enhanced DNAPL Recovery***
Threshold Criteria							
Protection of Human Health and Environment	*Does Not Meet*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Compliance with ARARs	*Does not Meet*	*Partially Meets*	*Partially Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Balancing Criteria							
Long-Term Effectiveness and Permanence	*Does Not Meet*	*Partially Meets*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Reduction of Toxicity, Mobility, or Volume	*Does Not Meet*	*Does Not Meet*	*Partially Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Short-Term Effectiveness	*Does Not Meet*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Implementability	*N/A*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*	*Meets*
Cost	*$50,000*	*$129,000*	*$13.4 million*	*$4.6 million*	*$10.6 million*	*$14.3 million*	*$33.8 million*

7. Cost

The present worth cost of each alternative, using a 7% discount rate, is shown in Table 3.

8. State Acceptance

State acceptance of the preferred alternative will be evaluated after the public comment period ends. The state did indicate in a comment letter to EPA, dated March 31, 2015, that it preferred Alternative D5. All comments and EPA's responses to all comments will be available in the Responsiveness Summary of the ROD.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends. Community comments and EPA's responses to all comments will be available in the Responsiveness Summary of the ROD.

Table 3 – Detailed Costs of Each DNAPL Alternative (using 7% discount rate)

Alternative	Total Capital Cost ($)	Duration of Operation (Years)	Total O&M Cost, No Discount Factor	Total Present Value Cost of O&M	Total Present Value Cost of Alternative
D1 – No Action	$ 0	0	$120,000	$50,000	$50,000
D2 – Institutional Control	$79,000	30	$120,000	$50,000	$129,000
D3 – Vertical Engineered Barrier	$3,684,000	30	$23,000,000	$9,614,000	$13,400,000
D4 – Horizontal Well DNAPL Recovery	$1,839,000	31	$7,000,000	$2,808,000	$4,647,000
D5 – Physically-Enhanced DNAPL Recovery	$4,446,000	7	$8,000,000	$6,130,000	$10,576,000
D6 – Chemically-Enhanced DNAPL Recovery	$8,845,000	4	$6,500,000	$5,490,000	$14,335,000
D7 – Thermally-Enhanced DNAPL Recovery	$26,968,000	4	$8,024,000	$6,800,000	$33,768,000

IX. EPA'S PREFERRED ALTERNATIVE

EPA's preferred alternative is **Alternative D5** – Physically Enhanced DNAPL Recovery (see Figure 7). Under Superfund law, the selected remedy must meet the threshold criteria of Overall Protection of Human Health and the Environment, and Compliance with ARARs. Alternative D5 will be protective of human health and environment by removing DNAPL mass from the aquifer, thereby achieving the RAO. Removal of DNAPL from the base of the aquifer will minimize the potential for DNAPL-contaminated groundwater to migrate to Lake Michigan and the Waukegan River. Furthermore, DNAPL removal is expected to improve the quality of groundwater and soil vapor, enabling a suitable remedy to be selected for these media in a final ROD. Removal of DNAPL will also reduce the risk to potential future construction workers performing excavations at the site.

Alternative D5 will also comply with location and site-specific ARARs identified in the FFS.

Long-term effectiveness and permanence will be achieved by Alternative D5 by effectively and aggressively removing the recoverable portion of the DNAPL at a relatively short time period (7 years), which is currently contaminating the groundwater above. Alternative D5 provides for permanently reducing the volume of DNAPL by sending the recovered portions off site for destruction, and it is expected to provide for treatment of a significant volume of DNAPL. The preferred alternative will be implementable because equipment and supplies are readily available for construction of the remedy. Alternative D5 will be short-term effective because construction time is of a short duration and workers and the community can be protected through standard safety measures.

The final two criteria, state acceptance and community acceptance, will be evaluated after the public comment period for this Proposed Plan.

Estimated Capital Cost: $4,446,000
Estimated Annual O&M Cost: $6,130,000
Estimated Total Present Worth Cost: $10,576,000
Estimated Construction/Implementation Timeframe: 7 years

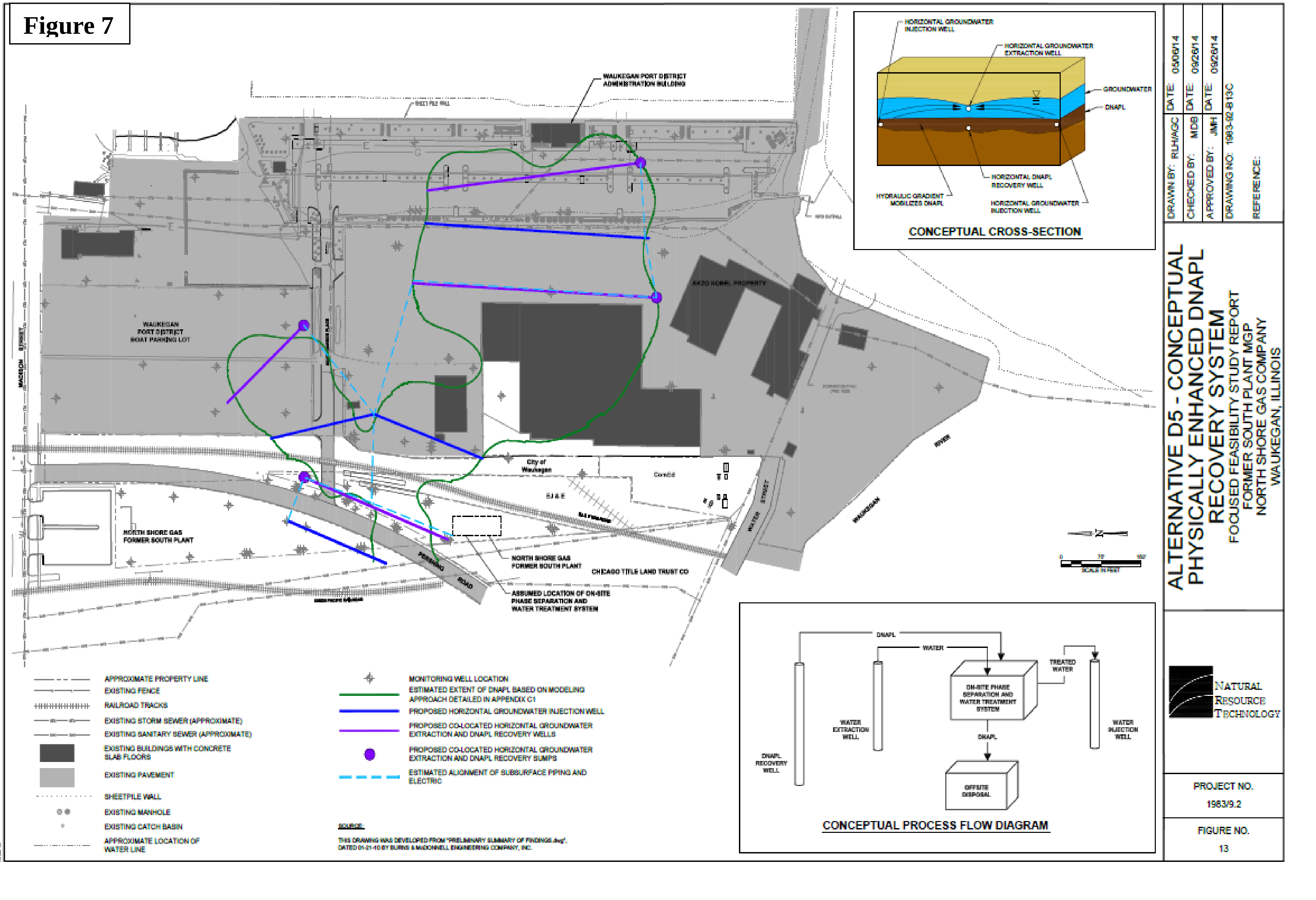
X. COMMUNITY PARTICIPATION

EPA relies on public input so that the remedy selected for each Superfund site meets the needs and concerns of the local community.

Public Comment Period – To ensure that the community's concerns are being addressed, EPA will open a public comment period on May 6, 2015 and close it on June 5, 2015. During this time the public is encouraged to submit comments on the Proposed Plan. A public meeting about EPA's Preferred Alternative will take place on May 20, 2015 at Bowen Park – Lilac Cottage, 1911 Sheridan, Waukegan, IL.

It is important to note that although EPA has proposed a preferred alternative, the final remedy has not yet been selected for the site. All comments received will be considered and addressed by EPA before the final remedy is selected.

Figure 7


WAUKEGAN PORT DISTRICT ADMINISTRATION BUILDING
WAUKEGAN PORT DISTRICT BOAT PARKING LOT
AKZO NOBEL PROPERTY
NORTH SHORE GAS FORMER SOUTH PLANT
CHICAGO TITLE LAND TRUST CO
ASSUMED LOCATION OF ON-SITE PHASE SEPARATION AND WATER TREATMENT SYSTEM
City of Waukegan
ComEd
EJ & E
MADISON STREET
WATER STREET
PERSHING ROAD
WAUKEGAN RIVER
HORIZONTAL GROUNDWATER INJECTION WELL
HORIZONTAL GROUNDWATER EXTRACTION WELL
GROUNDWATER
DNAPL
HORIZONTAL DNAPL RECOVERY WELL
HYDRAULIC GRADIENT MOBILIZES DNAPL
HORIZONTAL GROUNDWATER INJECTION WELL
CONCEPTUAL CROSS-SECTION
DNAPL
WATER
TREATED WATER
ON-SITE PHASE SEPARATION AND WATER TREATMENT SYSTEM
WATER EXTRACTION WELL
WATER INJECTION WELL
DNAPL RECOVERY WELL
DNAPL
OFFSITE DISPOSAL
CONCEPTUAL PROCESS FLOW DIAGRAM
APPROXIMATE PROPERTY LINE
EXISTING FENCE
RAILROAD TRACKS
EXISTING STORM SEWER (APPROXIMATE)
EXISTING SANITARY SEWER (APPROXIMATE)
EXISTING BUILDINGS WITH CONCRETE SLAB FLOORS
EXISTING PAVEMENT
SHEETPILE WALL
EXISTING MANHOLE
EXISTING CATCH BASIN
APPROXIMATE LOCATION OF WATER LINE
MONITORING WELL LOCATION
ESTIMATED EXTENT OF DNAPL BASED ON MODELING APPROACH DETAILED IN APPENDIX C1
PROPOSED HORIZONTAL GROUNDWATER INJECTION WELL
PROPOSED CO-LOCATED HORIZONTAL GROUNDWATER EXTRACTION AND DNAPL RECOVERY WELLS
PROPOSED CO-LOCATED HORIZONTAL GROUNDWATER EXTRACTION AND DNAPL RECOVERY SUMPS
ESTIMATED ALIGNMENT OF SUBSURFACE PIPING AND ELECTRIC
SOURCE:
THIS DRAWING WAS DEVELOPED FROM "PRELIMINARY SUMMARY OF FINDINGS.dwg", DATED 01-21-10 BY BURNS & McDONNELL ENGINEERING COMPANY, INC.
SCALE IN FEET
DRAWN BY: RLH/AGC DATE: 05/06/14
CHECKED BY: MDB DATE: 09/26/14
APPROVED BY: JMH DATE: 09/26/14
DRAWING NO: 1983-92-B13C
REFERENCE:
ALTERNATIVE D5 - CONCEPTUAL PHYSICALLY ENHANCED DNAPL RECOVERY SYSTEM
FOCUSED FEASIBILITY STUDY REPORT
FORMER SOUTH PLANT MGP
NORTH SHORE GAS COMPANY
WAUKEGAN, ILLINOIS
NATURAL RESOURCE TECHNOLOGY
PROJECT NO.
1983/9.2
FIGURE NO.
13

Detailed information on the material discussed in this document may be found in the site Administrative Record. These materials include the RI, the FFS and other information used by EPA in the decision-making process. EPA encourages the public to review the Administrative Record in order to gain a more comprehensive understanding of the site and the Superfund activities that have taken place there. Copies of the Administrative Record are available at the following locations:

U.S. EPA-Region 5 Record Center, Room 711 77 West Jackson Boulevard Chicago, IL 60604 Monday – Friday 8 a.m. to 4 p.m.	Waukegan Public Library 128 N. County Street Waukegan, Illinois Hours: 10AM – 6PM (847) 623-2041

Written comments, questions about the Proposed Plan, and requests for information can be sent to either representative below:

Ross del Rosario (SR-6J) Remedial Project Manager Region 5 EPA 77 West Jackson Blvd Chicago, IL 60406 Delrosario.rosauro@epa.gov	Heriberto Leon (SR-5J) Community Involvement Coordinator Region 5 EPA 77 West Jackson Blvd Chicago, IL 60406 Leon.heriberto@epa.gov

Following the conclusion of the public comment period on the Proposed Plan, EPA will prepare a Responsiveness Summary. The Responsiveness Summary will summarize and respond to comments on EPA's preferred alternative. EPA will then prepare a formal decision document, the Record of Decision (ROD), that summarizes the decision process and the alternative selected for the site. The ROD will include the Responsiveness Summary. Copies of the ROD will be available for public review in the information repositories listed above.